FIGURE 1 – _

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Interfacing Engineering Applications to the Three-Tier Data Model Architecture
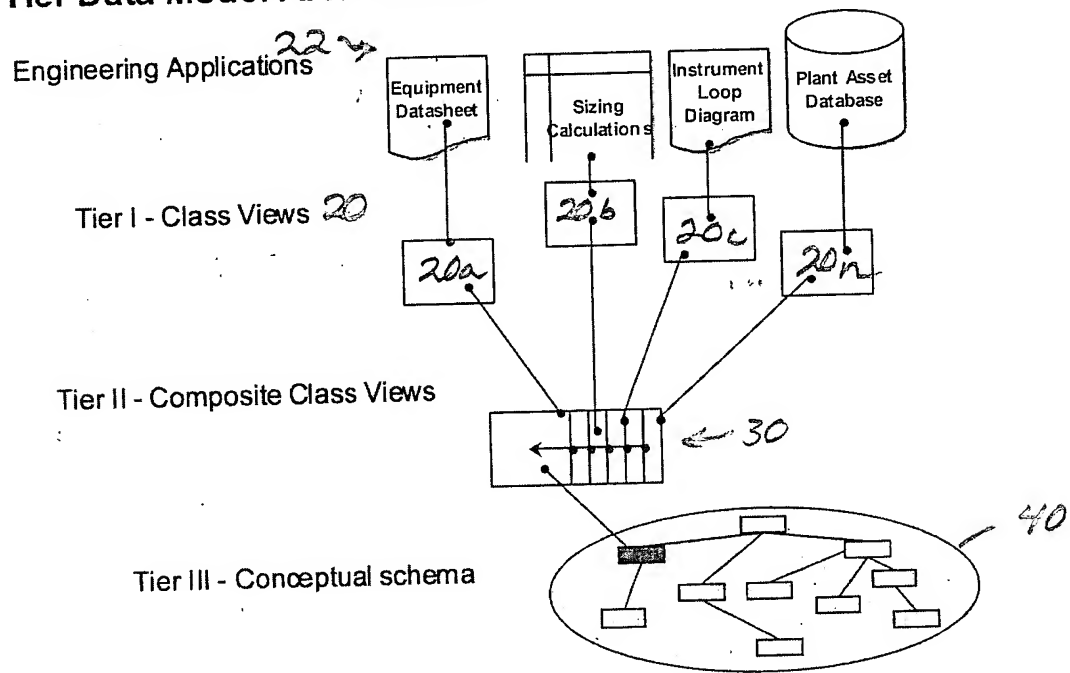
Engineering Applications *22*

Equipment Datasheet

Sizing Calculations

Instrument Loop Diagram

Plant Asset Database

Tier I - Class Views *20*

20a *20b* *20c* *20n*

Tier II - Composite Class Views

30

Tier III - Conceptual schema

40

2

Figure 2. Preferred embodiment of a conceptual model for process engineering

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ProcessUnitOperation ♦|

- UoSeparator ○
- UoReactor ○
- UoPressureChanger ○
- UoSplitter ○
- UoCrusher
- UoScreen
- UoMixer
- UoPipeline
- UoUserDefined
- UoHeatExchanger
- UoFiredHeater
- UoFlash
- UoSolidsDryer
- UoDistillation
- UoComplexDistillation

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ProcessPlantEquipment ♦|

- ProcessVessel ○
- SizeReductionEquipment
- ProcessEquipmentDriver ○
- MixingEquipment ○
- MaterialTransferEquipment ○
- HeatTransferEquipment ○   32
- MechanicalComponent ○
- SolidSeparationEquipment ○
- ProtectionSystem ○
- TransmissionPipeline
- ElectricalSupplyEquipment
- UtilitySystem ○
- MechanicalEquipment
- Stockpile
- ControlEquipment ○
- WeighingEquipment ○
- ProtectionDevice ○
- ControlLoop

PlantItem ♦

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ProcessPlantEquipmentAggregate ♦|

- ProcessPlant
- ProcessArea
- ProcessTrain
- ProcessControlUnit ○
- ProcessUnit

Node ♦|——►FittingNode

PipingSystem ♦

- UoPipingSystem
- PfdPipingSystem ♦

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MaterialPipingSystem ♦|

- PrimaryPipingSystem
- SecondaryPipingSystem
- UtilityPipingSystem

ControlPipingSystem ♦——►InstrumentLine
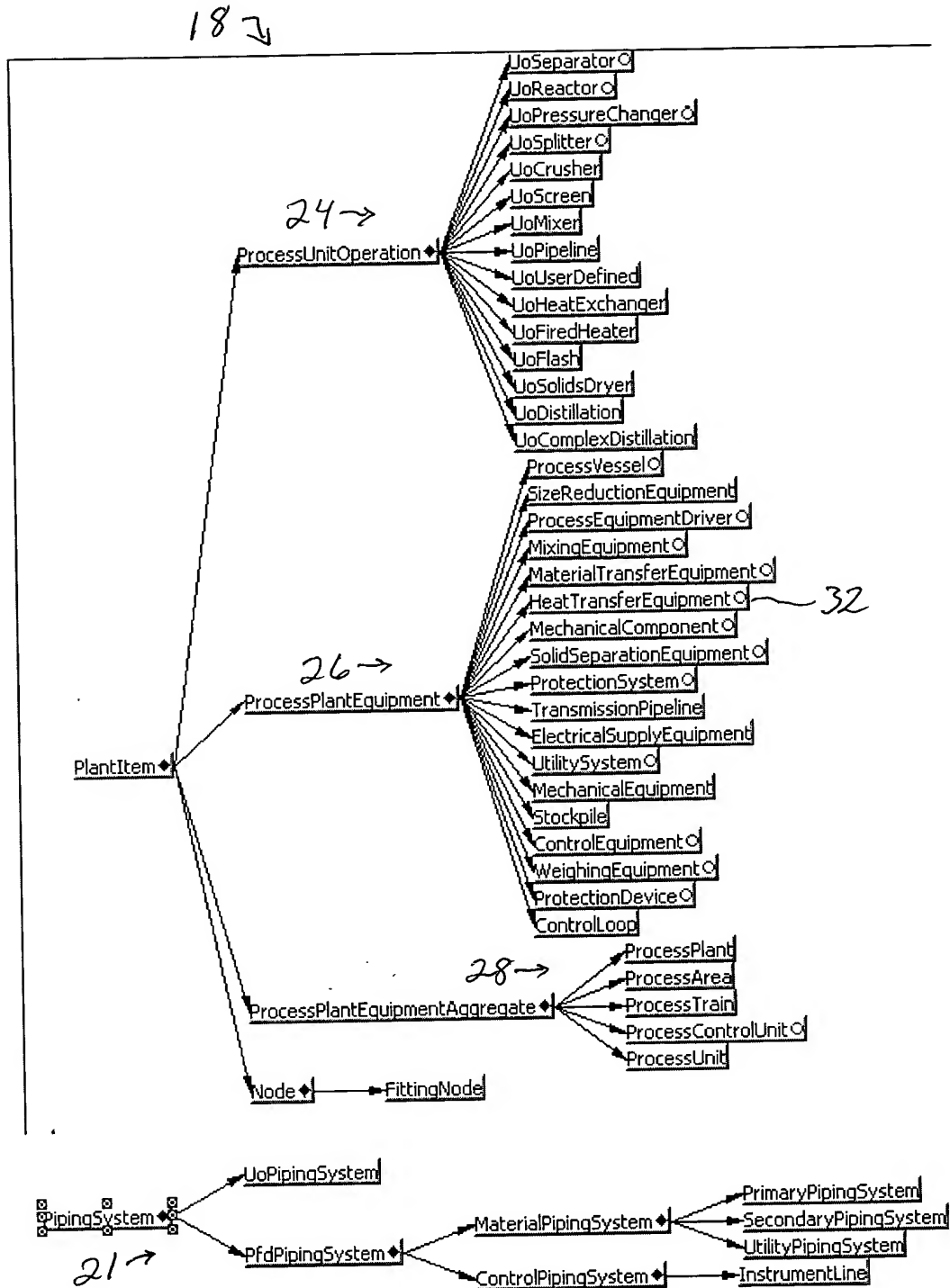
FIGURE 3A Structure and attributes of part of the Conceptual Model for the shell and tube heat exchanger equipment class

32   7   46   48

Class 'ShellAndTubeHeatExchanger'   _ |□| x|

Name *42*	Type *44*	Quantity Type	Source
DefaultSymbol	String		ShellAndTubeHeatExchanger
Type	String		ShellAndTubeHeatExchanger
TEMAClass	eTemaClass(ShellAndTubeHeatExchanger)		ShellAndTubeHeatExchanger
TEMAType	String		ShellAndTubeHeatExchanger
TEMARemarks	String		ShellAndTubeHeatExchanger
TEMAOrientation	eTemaOrientation_PIP VEDST003_		ShellAndTubeHeatExchanger
AdditionalRemarks	String		ShellAndTubeHeatExchanger
☐ Assemblies	ShellAndTubeAssembly		ShellAndTubeHeatExchanger
⊞ Bundle	ExchangerBundle		ShellAndTubeAssembly
⊞ Ends	ExchangerEnd		ShellAndTubeAssembly
⊞ Channel	ExchangerChannel		ShellAndTubeAssembly
⊞ Gasket	Gasket		ShellAndTubeAssembly
⊞ Piping	ExchangerPiping		ShellAndTubeAssembly
☐ ShellSide	ExchangerShell		ShellAndTubeAssembly
⊞ Shell	Shell		ExchangerShell
NumberShellPasses	Integer		ExchangerShell
BodyFlangeType	eBodyFlangeType(ExchangerShell)		ExchangerShell
⊞ BodyFlangeMaterial	ConstructionMaterial		ExchangerShell
⊞ ExternalBoltingMaterial	ConstructionMaterial		ExchangerShell
⊞ InternalBoltingMaterial	ConstructionMaterial		ExchangerShell
⊞ NozzleFlangeMaterial	ConstructionMaterial		ExchangerShell
⊞ NozzleNeckMaterial	ConstructionMaterial		ExchangerShell
⊞ NozzleReinforcementMaterial	ConstructionMaterial		ExchangerShell
⊞ PipeAndStubEndMaterial	ConstructionMaterial		ExchangerShell
CoverType	eShellCoverType(ExchangerShell)		ExchangerShell
⊞ CoverMaterial	ConstructionMaterial		ExchangerShell
TemaShellType	eShellTEMAType		ExchangerShell
InnerDiameter	Real	Length normal	ExchangerShell
OrientationAngle	Real	Plane angle PQT	ExchangerShell
OuterDiameter	Real	Length normal	ExchangerShell
RearSupportPlateType	String		ExchangerShell
Thickness	Real	Length small	ExchangerShell
VerticalHeight	Real	Length normal	ExchangerShell
EffectiveArea	Real	Area normal	ExchangerShell
TotalArea	Real	Area normal	ExchangerShell
AverageMetalTemperature	Real	Temperature tmp	ExchangerShell
⊞ Velocities	ExchangerFluidVelocity		ExchangerShell
ExpansionJointRequired	Boolean		ExchangerShell
⊞ ExpansionJoints	ExpansionJoint		ExchangerShell
⊞ FrontEndVapourBelt	VapourBelt		ExchangerShell
⊞ RearEndVapourBelt	VapourBelt		ExchangerShell
KettleInnerDiameter	Real	Length normal	ExchangerShell
KettleOuterDiameter	Real	Length normal	ExchangerShell
KettlePortAngle	Real	Plane angle PQT	ExchangerShell
KettlePortLength	Real	Length normal	ExchangerShell
KettleType	eKettleType(ExchangerShell)		ExchangerShell
⊞ ChannelMaterial	ConstructionMaterial		ExchangerShell
⊞ ChannelCoverMaterial	ConstructionMaterial		ExchangerShell
⊞ FloatingHeadCoverMaterial	ConstructionMaterial		ExchangerShell
⊞ Lining	ConstructionMaterial		ExchangerShell
⊞ Gasket	Gasket		ExchangerShell
InletAtChannelEnd	Boolean		ExchangerShell
NumberCondensateNozzles	Integer		ExchangerShell

FIGURE 3B (continued) Structure and attributes of part of the Conceptual Model for the shell and tube heat exchanger equipment class 327

Name 42	Type 44	Quantity Type 46	Source 48
NumberInletNozzles	Integer		ExchangerShell
NumberIntermediateNozzles	Integer		ExchangerShell
NumberLiquidOnlyOutletNozzles	Integer		ExchangerShell
NumberOutletNozzles	Integer		ExchangerShell
NumberVapourOnlyOutletNozzles	Integer		ExchangerShell
InletNozzleLocation	eInletNozzleLocation(ExchangerShell)		ExchangerShell
MechanicalCleaning	String		ExchangerShell
EntranceConstruction	eEntranceConstruction(ExchangerShell)		ExchangerShell
ExitConstruction	eExitConstruction(ExchangerShell)		ExchangerShell
⊞ MassBalanceIn	UoPort		ExchangerShell
⊞ MassBalanceOut	UoPort		ExchangerShell
MaximumHydrogenPartialPressure	Real	Pressure abs	ExchangerSide
MaximumH2sPartialPressure	Real	Pressure abs	ExchangerSide
NumberOfPasses	Integer		ExchangerSide
Remarks	String		MechanicalComponent
NamePrecedent	String		MechanicalComponent
ApplicableTo	eApplicableTo(ProcessPlantEquipment)		ProcessPlantEquipment
DefaultSymbol	String		ProcessPlantEquipment
ConstructionStatus	eConstructionStatus		ProcessPlantEquipment
NamePrecedent	String		ProcessPlantEquipment
⊞ MaterialPorts	MaterialPort		ProcessPlantEquipment
⊞ SignalPorts	SignalPort		ProcessPlantEquipment
EquipmentFunction	String		ProcessPlantEquipment
Manufacturer	String		ProcessPlantEquipment
PurchasedCapitalCost	Real	Currency	ProcessPlantEquipment
DeliveredCapitalCost	Real	Currency	ProcessPlantEquipment
InstalledCapitalCost	Real	Currency	ProcessPlantEquipment
NumberOfSpares	Integer		ProcessPlantEquipment
NumberInService	Integer		ProcessPlantEquipment
NumberRequired	Integer		ProcessPlantEquipment
PidNumber	String		ProcessPlantEquipment
Size	String		ProcessPlantEquipment
Function	String		ProcessPlantEquipment
OperatingFactor	String		ProcessPlantEquipment
Model	String		ProcessPlantEquipment
SerialNumber	String		ProcessPlantEquipment
ManufacturersSerialNumber	String		ProcessPlantEquipment
FabricatorsSerialNumber	String		ProcessPlantEquipment
OperationMode	eOperationMode(MechanicalEquipment)		ProcessPlantEquipment
⊞ MaterialSchedule	ConstructionMaterial		ProcessPlantEquipment
⊞ ShippingRequirements	ShippingRequirements		ProcessPlantEquipment
⊞ Location	Location		ProcessPlantEquipment
⊞ NoiseSpecification	NoiseSpecification		ProcessPlantEquipment
⊞ SpaceRequired	SpaceRequirement		ProcessPlantEquipment
⊞ InspectionAndTests	InspectionAndTests		ProcessPlantEquipment
⊞ DesignCodes	DesignCode		ProcessPlantEquipment
⊞ SpareParts	SpareParts		ProcessPlantEquipment
⊞ Weights	Weights		ProcessPlantEquipment
⊞ Represents	ProcessUnitOperation		ProcessPlantEquipment
⊞ NormalOperatingCriteria	OperatingCriteria		ProcessPlantEquipment
⊞ MaximumOperatingCriteria	OperatingCriteria		ProcessPlantEquipment
⊞ MinimumOperatingCriteria	OperatingCriteria		ProcessPlantEquipment
⊞ NormalContents	MaterialAmountSpecification		ProcessPlantEquipment

Class 'ShellAndTubeHeatExchanger'

FIGURE 3C (continued) Structure and attributes of part of the Conceptual Model for the shell and tube heat exchanger equipment class   32₂

Name 42	Type 44	Quantity Type 46	Source 48
⊞ NormalContents	MaterialAmountSpecification		ProcessPlantEquipment
⊞ MinimumContents	MaterialAmountSpecification		ProcessPlantEquipment
⊞ MaximumContents	MaterialAmountSpecification		ProcessPlantEquipment
ManufacturerAddress1	String		ProcessPlantEquipment
ManufacturerAddress2	String		ProcessPlantEquipment
ManufacturerPhone	String		ProcessPlantEquipment
Fabricator	String		ProcessPlantEquipment
FabricatorAddress1	String		ProcessPlantEquipment
FabricatorAddress2	String		ProcessPlantEquipment
FabricatorPhone	String		ProcessPlantEquipment
SuppliedBy	ePurchaserOrManufacturer		ProcessPlantEquipment
MountedBy	ePurchaserOrManufacturer		ProcessPlantEquipment
ModelNumber	String		ProcessPlantEquipment
ApplicableStandard	String		ProcessPlantEquipment
Orientation	String		ProcessPlantEquipment
⊞ Customer	ProcessPlantCorporation		ProcessPlantEquipment
JobNumber	String		ProcessPlantEquipment
PoNumber	String		ProcessPlantEquipment
PoDate	String		ProcessPlantEquipment
InquiryBy	String		ProcessPlantEquipment
InquiryNumber	String		ProcessPlantEquipment
SpecificationNumber	String		ProcessPlantEquipment
RequisitionNumber	String		ProcessPlantEquipment
SAPNumber	String		ProcessPlantEquipment
⊞ MaximumUtilities	SiteUtilityService		ProcessPlantEquipment
⊞ MinimumUtilities	SiteUtilityService		ProcessPlantEquipment
⊞ Utilities	SiteUtilityService		ProcessPlantEquipment
⊞ UtilitySummary	UtilitySummary		ProcessPlantEquipment
⊞ PaintSpecifications	PaintSpecifications		ProcessPlantEquipment
Mounting	Boolean		ProcessPlantEquipment
CostingReference	String		ProcessPlantEquipment
⊞ CostData	Cost		ProcessPlantEquipment
⊞ ControlEquipment	ControlEquipment		ProcessPlantEquipment
⊞ Documentation	Documentation		ProcessPlantEquipment
⊞ SupplierData	ProcessPlantCorporation		ProcessPlantEquipment
⊞ CustomerData	ProcessPlantCorporation		ProcessPlantEquipment
⊞ FabricatorData	ProcessPlantCorporation		ProcessPlantEquipment
⊞ ManufacturerData	ProcessPlantCorporation		ProcessPlantEquipment
⊞ Purchaser	ProcessPlantCorporation		ProcessPlantEquipment
Type	String		PlantItem
ItemNumber	String		PlantItem
ItemSequenceNumber	String		PlantItem
ItemSuffix	String		PlantItem
CompleteItemNumber	String		PlantItem
⊞ Comments	Comment		PlantItem
Notes	String		PlantItem
Description	String		PlantItem
⊞ NormalDesignCriteria	DesignCriteria		PlantItem
⊞ MinimumDesignCriteria	DesignCriteria		PlantItem
⊞ MaximumDesignCriteria	DesignCriteria		PlantItem
CaseName	String		PlantItem
⊞ MaterialOfConstruction	ConstructionMaterial		PlantItem
⊞ Insulation	ConstructionMaterial		PlantItem

Class 'ShellAndTubeHeatExchanger'

FIGURE 3D (continued) Structure and attributes of part of the Conceptual Model for the shell and tube heat exchanger equipment class 3 2   2

Name 42	Type 44	Quantity Type 46	Source 48
⊞ Insulation	ConstructionMaterial		PlantItem
⊟ Nozzles	Nozzle		PlantItem
EntranceType	eEntranceType(Nozzle)		Nozzle
NozzleFunction	eNozzleFunction(Nozzle)		Nozzle
NozzleMark	String		Nozzle
Number	Integer		Nozzle
NozzleType	eType(Nozzle)		Nozzle
NozzleOrientation	Real	Plane Angle	Nozzle
FlangeAndGasketByVendor	Boolean		Nozzle
FlangedOrStudded	eFlangedOrStuddedNozzle		Nozzle
DesignApprovalRequired	Boolean		Nozzle
DistanceFromCenter	Real	Length	Nozzle
HeightUnderNozzle	Real	Length	Nozzle
LocationRelativeToUbend	eLocationRelativeToUbend(Nozzle)		Nozzle
Position	ePosition(Nozzle)		Nozzle
Facing	eFacing(Nozzle)		Nozzle
⊞ Lining	ConstructionMaterial		Nozzle
Reinforced	String		Nozzle
Bore	Real	Length	Nozzle
NominalSize	Real	Length	Nozzle
OuterDiameter	Real	Length	Nozzle
Rating	eRating(Nozzle)		Nozzle
PressureRating	Real	Pressure	Nozzle
TemperatureRating	Real	Temperature	Nozzle
FlangeVelocity	Real	Velocity	Nozzle
PressureDrop	Real	Pressure Diff	Nozzle
Rhov2	Real	Density Velocity Sq.	Nozzle
Velocity	Real	Velocity	Nozzle
AllowableForceAxial	Real	Force	Nozzle
AllowableForceHorizontal	Real	Force	Nozzle
AllowableForceVertical	Real	Force	Nozzle
AllowableMomentAxial	Real	Bending Moment(Torq	Nozzle
AllowableMomentHorizontal	Real	Bending Moment(Torq	Nozzle
AllowableMomentVertical	Real	Bending Moment(Torq	Nozzle
⊞ DistributorBelt	DistributorBelt		Nozzle
⊞ Flange	Flange		Nozzle
Flanged	eFlanged(Nozzle)		Nozzle
⊞ Gasket	Gasket		Nozzle
MatingPartsFurnished	Boolean		Nozzle
⊞ NozzleDome	NozzleDome		Nozzle
⊞ PipingTerminator	PipingTerminator		Nozzle
VortexBreaker	Boolean		Nozzle
Threaded	Boolean		Nozzle
ThreadParameterA	Real	Length	Nozzle
ThreadParameterB	Real	Length	Nozzle
ThreadParameterC	Real	Length	Nozzle
ThreadParameterD	Real	Length	Nozzle
ThreadParameterE	Real	Length	Nozzle
⊞ LinePipeMaterial	ConstructionMaterial		Nozzle
⊞ ReinforcingPlateMaterial	ConstructionMaterial		Nozzle
Remarks	String		MechanicalComponent
NamePrecedent	String		MechanicalComponent
ApplicableTo	eApplicableTo(ProcessPlantEquipment)		ProcessPlantEquipment

FIGURE 4a Structure and attributes of the Composite View for a shell and tube heat exchanger

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Composite View 'ShellAndTubeHeatExchanger' _ □ ×

Name	Type	Quantity Type	Route
AdditionalRemarks	String		AdditionalRemarks
BaffleCut	Real	Percentage PQT	Assemblies.Bundle.Baffles.BaffleCut
BaffleCutOrientation	String		Assemblies.Bundle.Baffles.Orientation
BaffleCutType	String		
BafflePercentageCutForAreaBasis	Real	Percentage	Assemblies.Bundle.Baffles.PercentAreaCut
BafflePercentageCutForShellInnerDiamete	Real	Percentage	Assemblies.Bundle.Baffles.PercentDiameterFirstCut
BafflePitch	Real	Length normal	Assemblies.Bundle.Baffles.Pitch
BafflePitchMaximum	Real	Length small	
BafflesAndSupportPlates	String		Assemblies.Bundle.Baffles.MaterialOfConstruction.MaterialName
BaffleShellDiametralClearance	Real	Length normal	Assemblies.Bundle.BaffleToShellClearance
BafflesMaterial	String		Assemblies.Bundle.Baffles.MaterialOfConstruction.MaterialName
BafflesNumber	Integer		Assemblies.Bundle.NumberOfBaffles
BafflesNumberAllowable	String		
BafflesNumberMinimize	Boolean		
BaffleSpacing	Real	Length	Assemblies.Bundle.NominalBaffleSpacing
BaffleSpacingFromInlet	Real	Length	Assemblies.Bundle.Tubesheets(1).DistanceFromFrontTubeSheetFace
BaffleSpacingFromOutlet	Real		
BaffleSpacingMaximum	Real	Length small	
BaffleSpacingMinimum	Real	Length small	
BafflesPresent	String		
BafflesSpacersTieRodsCorrosionAllowance	Real	Length small	Assemblies.Bundle.Tubesheets(1).TieRods.MaterialOfConstruction.CorrosionAllowance
BafflesSpacersTieRodsMaterial	String		Assemblies.Bundle.Tubesheets(1).TieRods.MaterialOfConstruction.MaterialName
BaffleThickness	Real	Length small	Assemblies.Bundle.Baffles.Thickness
BaffleType	eType(ExchangerBaffle)		Assemblies.Bundle.Baffles.BaffleType
BundleDiameter	Real	Length	
BundleEntranceRv2	Real	Density Velocity Sq	Assemblies.PerformanceCriteria.ShellsidePerformance.BundleEntranceRhov2
BundleExitRv2	Real	Density Velocity Sq	Assemblies.PerformanceCriteria.ShellsidePerformance.BundleExitRhov2
BundleFirstTubeRowToInletDistance	Real	Length small	
BundleLastTubeRowToOutletDistance	Real	Length small	
BundleOuterDiameterMaximum	Real	Length (m)	Assemblies.Bundle.MaximumDesignCriteria(1).BundleOuterDiameter
BundleShellDiametralClearance	Real	Length small	
BundleWeight	Real	Mass	Assemblies.Bundle.Weights.TotalOperating
BundleNormalOrFull	String		
BypassSealRequired	Boolean		Assemblies.Bundle.BypassSeal.BypassSealRequired
ByPassSealType	String		Assemblies.Bundle.BypassSeal.SealType
ChannelBodyFlangeMaterial	String		Assemblies.Channel.BodyFlangeMaterial.MaterialName
ChannelBodyFlangesCorrosionAllowance	Real	Length small	Assemblies.Channel.BodyFlangeMaterial.CorrosionAllowance
ChannelCorrosionAllowance	Real	Length small	Assemblies.Channel.ChannelMaterial.CorrosionAllowance
ChannelCoverCorrosionAllowance	Real	Length small	Assemblies.Channel.CoverMaterial.CorrosionAllowance
ChannelCoverMaterial	String		Assemblies.Channel.CoverMaterial.MaterialName
ChannelExitInsulationMaterial	String		Assemblies.Channel.ExitInsulationMaterial.MaterialName
ChannelExitInsulationThickness	Real	Length small	Assemblies.Channel.ExitInsulationMaterial.Thickness
ChannelExternalBoltingCorrosionAllowanc	Real	Length small	Assemblies.Channel.ExternalBoltingMaterial.CorrosionAllowance
ChannelExternalBoltingMaterial	String		Assemblies.Channel.ExternalBoltingMaterial.MaterialName
ChannelHeadCorrosionAllowance	Real	Length small	Assemblies.Channel.CoverMaterial.CorrosionAllowance
ChannelHeadMaterial	String		Assemblies.Channel.CoverMaterial.MaterialName
ChannelInletInsulationMaterial	String		Assemblies.Channel.InletInsulationMaterial.MaterialName
ChannelInletInsulationThickness	Real	Length small	Assemblies.Channel.InletInsulationMaterial.Thickness
ChannelInternalBoltingCorrosionAllowance	Real	Length small	Assemblies.Channel.InternalBoltingMaterial.CorrosionAllowance
ChannelInternalBoltingMaterial	String		Assemblies.Channel.InternalBoltingMaterial.MaterialName
ChannelMaterial	String		Assemblies.Channel.ChannelMaterial.MaterialName
ChannelNozzleFlangeMaterial	String		Assemblies.Channel.NozzleFlangeMaterial.MaterialName
ChannelNozzleFlangesCorrosionAllowance	Real	Length small	Assemblies.Channel.NozzleFlangeMaterial.CorrosionAllowance

FIGURE 4.b(continued) Structure and attributes of the Composite View for a shell and tube heat exchanger   34 λ   36

Name	Type	Quantity Type	Route
			Composite View 'ShellAndTubeHeatExchanger'
ChannelNozzleNeckMaterial	String		Assemblies.Channel.NozzleNeckMaterial.MaterialName
ChannelNozzleNecksCorrosionAllowance	Real	Length small	Assemblies.Channel.NozzleNeckMaterial.CorrosionAllowance
ChannelNozzleReinforcementCorrosionAllowance	Real	Length small	Assemblies.Channel.NozzleReinforcementMaterial.CorrosionAllowance
ChannelNozzleReinforcementMaterial	String		Assemblies.Channel.NozzleReinforcementMaterial.MaterialName
ChannelPipeandstubEndsCorrosionAllowance	Real	Length small	Assemblies.Channel.PipeAndStubEndsMaterial.CorrosionAllowance
ChannelPipeandstubEndsMaterial	String		Assemblies.Channel.PipeAndStubEndsMaterial.MaterialName
CodeRequirements	String		AsmeCode
ColdInletStream	MaterialFlowSpecificatio		MaterialPorts[ThermalAllocation="ColdIn"].Flow
ColdOutletStream	MaterialFlowSpecificatio		MaterialPorts[ThermalAllocation="ColdOut"].Flow
ColdSideDesignPressure	Real	Pressure abs	ColdSide.NormalDesignCriteria.Pressure
ColdSideDesignTemperature	Real	Temperature tmp	ColdSide.NormalDesignCriteria.Temperature
ColdSideFlangeFacing	String		ColdSide.FlangeFacing
ColdSideFlangeRating	String		ColdSide.FlangeRating
ColdSideFluidAllocation	eHotFluidAllocation(Shel		NormalDesignCriteria(1).ColdFluidAllocation
ColdSideFluidName	String		MaterialPorts[ThermalAllocation="ColdIn"].Flow.Name
ColdSideFoulingResistance	Real	Thermal Resistance	ColdSide.FoulingResistance
ColdSideFoulingThickness	Real	Length small	ColdSide.Fouling.Thickness
ColdSideFullVacuum	Boolean		ColdSide.NormalDesignCriteria.FullVacuum
ColdSideGasketMaterial	String		
ColdSideHeatBalanceMethod	String		
ColdSideHeatCurves	ExchangerFluidProfile		ColdSide.FluidProfiles(*)
ColdSideInletEnthalpyMassBasis	Real	Enthalpy	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.EnthalpyMassBasis
ColdSideInletH2MoleConcentration	Real	Concentrn(Mol/Mol)	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.DefinedPointPhysicalProperties.Hydrog
ColdSideInletH2SMoleConcentration	Real	Concentrn(Mol/Mol)	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.DefinedPointPhysicalProperties.H2sMole
ColdSideInletInertMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdIn"].Flow.NonCondensibles.MolecularWeight
ColdSideInletMassQuality	Real	Fraction	MaterialPorts[ThermalAllocation="ColdIn"].Flow.VapourPhase.MassFraction
ColdSideInletPressure	Real	Pressure abs	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.Pressure
ColdSideInletTemperature	Real	Temperature tmp	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.Temperature
ColdSideInletVaporH2MFLOW	Real	Mass flow normal	MaterialPorts[ThermalAllocation="ColdIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyt
ColdSideInletVaporH2MW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyt
ColdSideInletVaporH2OMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.H2(
ColdSideInletVaporHydrocarbonMassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="ColdIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyt
ColdSideInletVaporHydrocarbonMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyt
ColdSideLiquidHeatTransferCoefficientSpecified	Real	Heat Transfer Coef	
ColdSideMassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.MassFlowRate
ColdSideMolecularWeight	Real	Molar Mass	MaterialPorts[ThermalAllocation="ColdIn"].Flow.BulkFlow.MolecularWeight
ColdSideOutletEnthalpyMassBasis	Real	Enthalpy	MaterialPorts[ThermalAllocation="ColdOut"].Flow.BulkFlow.EnthalpyMassBasis
ColdSideOutletH2MoleConcentration	Real	Concentrn(Mol/Mol)	MaterialPorts[ThermalAllocation="ColdOut"].Flow.BulkFlow.DefinedPointPhysicalProperties.Hydro
ColdSideOutletH2SMoleConcentration	Real	Concentrn(Mol/Mol)	MaterialPorts[ThermalAllocation="ColdOut"].Flow.BulkFlow.DefinedPointPhysicalProperties.H2sMc
ColdSideOutletInertMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdOut"].Flow.NonCondensibles.MolecularWeight
ColdSideOutletMassQuality	Real	Fraction	MaterialPorts[ThermalAllocation="ColdOut"].Flow.VapourPhase.MassFraction
ColdSideOutletPressure	Real	Pressure abs	MaterialPorts[ThermalAllocation="ColdOut"].Flow.BulkFlow.Pressure
ColdSideOutletTemperature	Real	Temperature tmp	MaterialPorts[ThermalAllocation="ColdOut"].Flow.BulkFlow.Temperature
ColdSideOutletVaporH2MassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="ColdOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.H
ColdSideOutletVaporH2MW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.H
ColdSideOutletVaporH2OMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.H
ColdSideOutletVaporHydrocarbonMassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="ColdOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.H
ColdSideOutletVaporHydrocarbonMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="ColdOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.H
ColdSidePhaseIndicator	eForm(MaterialFlowSpec		MaterialPorts[ThermalAllocation="ColdOut"].Flow.Form
ColdSidePressureDrop	Real	Pressure Diff	ColdSide.NormalOperatingCriteria.PressureDrop
ColdSidePressureDropAllowable	Real	Pressure Diff	ColdSide.MaximumDesignCriteria.AllowablePressureDrop
ColdSidePressureDropInNozzlesAllowable	Real		
ColdSideTestPressure	Real	Pressure abs	

FIGURE 4c (continued) Structure and attributes of the Composite View for a shell and tube heat exchanger   34½

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Composite View 'ShellAndTubeHeatExchanger'				_|□| x|
Name	Type	Quantity Type	Route
ColdSideTestPressure	Real	Pressure abs	
ColdSideTwoPhaseHeatTransferCoefficientSpecif	Real	Heat Transfer Coef	
ColdSideVacuumPressure	Real	Pressure vacuum	
ColdSideVacuumReferenceTemperature	Real	Temperature tmp	ColdSide.NormalDesignCriteria.VacuumTemperature
ColdSideVapourHeatTransferCoefficientSpecified	Real	Heat Transfer Coef	
ColdSideVelocityMaximumAllowable	Real	Velocity normal	
ColdSideVelocityMinimumAllowable	Real	Velocity normal	
ConnectionDescription	String		Nozzles(*).Description
ConnectionFacing	eFacing(Flange)		Nozzles(*).Flange.Facing
ConnectionMark	String		Nozzles(*).NozzleMark
ConnectionNumberRequired	Integer		Nozzles(*).NumberRequired
ConnectionRating	eRating(Nozzle)		Nozzles(*).Rating
ConnectionScheduleSize	Real	Length	Nozzles(*).NominalSize
CorrectedandweightedMtd	Real	Temperature Diff	PerformanceCriteria.LmtdWeighted
Correctedmtd	Real	Temperature Diff	PerformanceCriteria.LmtdCorrected
CostingUserTag	String		CostData.UserTag
Customer	String		Customer.AbbreviatedName
Description	String		Description
DesignGuidelines	String		DesignGuidelines(1)
DesignShellMeanMetalTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).MetalTemperature
DesignShellPressure	Real	Pressure gauge	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).Pressure
DesignTubeMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).MetalTemperature
DesignTubePressure	Real	Pressure gauge	NormalDesignCriteria(1).Pressure
DesignTubeSheetMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.Tubesheets(1).NormalDesignCriteria(1).MetalTemperature
DirectFieldCost	Real	Currency	CostData.DirectFieldCost
ExchangerIsDoublePipe	Boolean		ExchangerIsDoublePipe
ExchangerType	String		ExchangerType
ExchangerWeightEmpty	Real	Mass	Weights.Empty
ExchangerWeightFullOfWater	Real	Mass	Weights.WaterFilled
ExpansionJointDesignLifeCycles	Integer		Assemblies.ShellSide.ExpansionJoints.DesignLifeCycles
ExpansionJointMaterial	String		Assemblies.ShellSide.ExpansionJoints.MaterialOfConstruction.MaterialName
ExpansionJointRequired	Boolean		Assemblies.ShellSide.ExpansionJointRequired
ExpansionJointType	eType(ExpansionJoint)		Assemblies.ShellSide.ExpansionJoints.JointType
Fabricator	String		Fabricator
FloatingHeadCoverBoltMaterial	String		Assemblies.FloatingHead.CoverBoltMaterial.MaterialName
FloatingHeadCoverMaterial	String		Assemblies.FloatingHead.CoverMaterial.MaterialName
FloatingHeadGasketMaintenanceFactor	Real	Pressure abs	Assemblies.FloatingHead.Gasket.MaintenanceFactor
FloatingHeadGasketMaterial	String		Assemblies.FloatingHead.Gasket.MaterialOfConstruction.MaterialName
FloatingHeadGasketThickness	Real	Length small	Assemblies.FloatingHead.Gasket.MaterialOfConstruction.Thickness
FloatingHeadGasketYFactor	Real	Pressure abs	Assemblies.FloatingHead.Gasket.MaterialOfConstruction.MaximumYieldStrength
FrontEndTemaType	eTemaType(ExchangerE		Assemblies.Ends(1).TemaType
GasketsSpareSetsRequired	Integer		Assemblies.Gasket.NumberOfSpares
GeneralOfficeOverhead	Real	Currency	CostData.GeneralOfficeOverhead
HeatExchanged	Real	Power normal	PerformanceCriteria.PerformanceData(1).HeatDuty
HeatTransferRateClean	Real	Heat Transfer Coef	PerformanceCriteria.OverallCoefficientClean
HeatTransferRateFouled	Real	Heat Transfer Coef	PerformanceCriteria.OverallCoefficientFouled
HeatTransferRateRequired	Real	Heat Transfer Coef	PerformanceCriteria.OverallHeatTransferCoefficient
HotInletStream	MaterialFlowSpecificatior		MaterialPorts[ThermalAllocation="HotIn"].Flow
HotOutletStream	MaterialFlowSpecificatior		MaterialPorts[ThermalAllocation="HotOut"].Flow
HotSideDesignPressure	Real	Pressure abs	HotSide.NormalDesignCriteria.Pressure
HotSideDesignTemperature	Real	Temperature tmp	HotSide.NormalDesignCriteria.Temperature
HotSideEnthalpy	Real	Enthalpy	HotSide.HeatingCoolingCurve(1).DataPoints(*).BulkFlow.ThermodynamicProperties.SpecificEntha
HotSideFlangeFacing	String		HotSide.FlangeFacing

FIGURE 4d (continued) Structure and attributes of the Composite View for a shell and tube heat exchanger

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Name	Type	Quantity Type	Route
Composite View 'ShellAndTubeHeatExchanger'			_|□|×|
HotSideFlangeFacing	String		HotSide.FlangeFacing
HotSideFlangeRating	String		HotSide.FlangeRating
HotSideFluidAllocation	eHotFluidAllocation(Shel		NormalDesignCriteria(1).HotFluidAllocation
HotSideFluidName	String		MaterialPorts[ThermalAllocation="HotIn"].Flow.Name
HotSideFoulingResistance	Real	Therm resist PQT	HotSide.FoulingResistance
HotSideFoulingThickness	Real	Length small	HotSide.FoulingThickness
HotSideFullVacuum	Boolean		HotSide.NormalDesignCriteria.FullVacuum
HotSideFullVacuumReferenceTemperature	Real	Temperature tmp	HotSide.NormalDesignCriteria.VacuumTemperature
HotSideGasketMaterial	String		
HotSideHeatBalanceMethod	String		
HotSideHeatCurves	ExchangerFluidProfile		HotSide.FluidProfiles(*)
HotSideInletEnthalpyMassBasis	Real	Enthalpy	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.EnthalpyMassBasis
HotSideInletH2MoleConcentration	Real	Conc. % mol/mol	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.DefinedPointPhysicalProperties.Hydroge
HotSideInletH2SMoleConcentration	Real	Conc. % mol/mol	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.DefinedPointPhysicalProperties.H2sMole
HotSideInletInertMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotIn"].Flow.NonCondensibles.MolecularWeight
HotSideInletMassQuality	Real	Fraction	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.MassFraction
HotSideInletPressure	Real	Pressure abs	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.Pressure
HotSideInletTemperature	Real	Temperature tmp	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.Temperature
HotSideInletVaporFlowrate	Real	Mass flow small	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.MassFlowRate
HotSideInletVaporH2MassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyd
HotSideInletVaporH2MW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyd
HotSideInletVaporH2OMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.H20
HotSideInletVaporHydrocarbonMassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyd
HotSideInletVaporHydrocarbonMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotIn"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hyd
HotSideLiquidHeatTransferCoefficientSpecified	Real	Heat Transfer Coef	
HotSideMassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.MassFlowRate
HotSideMolecularWeight	Real	Molar Mass	MaterialPorts[ThermalAllocation="HotIn"].Flow.BulkFlow.MolecularWeight
HotSideOutletEnthalpyMassBasis	Real	Enthalpy	MaterialPorts[ThermalAllocation="HotOut"].Flow.BulkFlow.EnthalpyMassBasis
HotSideOutletH2MoleConcentration	Real	Conc. % mol/mol	MaterialPorts[ThermalAllocation="HotOut"].Flow.BulkFlow.DefinedPointPhysicalProperties.Hydroc
HotSideOutletH2SMoleConcentration	Real	Conc. % mol/mol	MaterialPorts[ThermalAllocation="HotOut"].Flow.BulkFlow.DefinedPointPhysicalProperties.H2sMol
HotSideOutletInertMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotOut"].Flow.NonCondensibles.MolecularWeight
HotSideOutletMassQuality	Real	Fraction	MaterialPorts[ThermalAllocation="HotOut"].Flow.VapourPhase.MassFraction
HotSideOutletPressure	Real	Pressure abs	MaterialPorts[ThermalAllocation="HotOut"].Flow.BulkFlow.Pressure
HotSideOutletTemperature	Real	Temperature	MaterialPorts[ThermalAllocation="HotOut"].Flow.BulkFlow.Temperature
HotSideOutletVaporH2MassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="HotOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hy
HotSideOutletVaporH2MW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hy
HotSideOutletVaporH2OMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.H2
HotSideOutletVaporHydrocarbonMassFlow	Real	Mass flow normal	MaterialPorts[ThermalAllocation="HotOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hy
HotSideOutletVaporHydrocarbonMW	Real	Molar Mass (g/mol)	MaterialPorts[ThermalAllocation="HotOut"].Flow.VapourPhase.DefinedPointPhysicalProperties.Hy
HotSidePhaseIndicator	eForm(MaterialFlowSpec		MaterialPorts[ThermalAllocation="HotIn"].Flow.Form
HotSidePressureDrop	Real	Pressure Diff	HotSide.NormalOperatingCriteria.PressureDrop
HotSidePressureDropAllowable	Real	Pressure Diff	HotSide.MaximumDesignCriteria.AllowablePressureDrop
HotSidePressureDropInNozzlesAllowable	Real		
HotSideTestPressure	Real	Pressure abs	
HotSideTwoPhaseHeatTransferCoefficientSpecifi	Real	Heat Transfer Coef	
HotSideVacuumPressure	Real	Pressure vacuum	
HotSideVapourHeatTransferCoefficientSpecified	Real	Heat Transfer Coef	
HotSideVelocityMaximumAllowable	Real	Velocity normal	
HotSideVelocityMinimumAllowable	Real	Velocity normal	
HydroTestPressureField	Real	Absolute Pressure	InspectionAndTests.HydrostaticTestPressureField
HydroTestPressureShop	Real	Absolute Pressure	InspectionAndTests.HydrostaticTestPressureShop
ImpingementProtection	Boolean		Assemblies.Bundle.ImpingementProtection
ImpingementProtectionType	ePlateType(Impingemen		Assemblies.Bundle.ImpingementPlate.PlateType

FIGURE 4e(continued) Structure and attributes of the Composite View for a shell and tube heat exchanger

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Name	Type	Quantity Type	Route
			Composite View 'ShellAndTubeHeatExchanger'
ImpingementProtectionType	ePlateType(Impingemen		Assemblies.Bundle.ImpingementPlate.PlateType
InletNozzleRv2	Real	Density Velocity Sq	Assemblies.PerformanceCriteria.ShellsidePerformance.LimitInletRhov2
InnerDiameter	Real	Length normal	Assemblies.ShellSide.InnerDiameter
InsulationDensity	Real	Density	Insulation.Density
InsulationMaterial	String		Insulation.MaterialName
InsulationPurpose	String		Insulation.Purpose
InsulationSpecification	String		Insulation.Specification
InsulationThickness	Real	Length small	Insulation.Thickness
ItemNumber	String		ItemNumber
JobNo	String		JobNumber
KettleDiameterInner	Real	Length small	
KettleDiameterOuter	Real	Length small	
Location	String		Location.Site
LongditudinalBaffleSealType	eSealType(LongitudinalE		Assemblies.Bundle.LongitudinalBaffles.SealType
LongitudinalBaffleType	String		Assemblies.Bundle.LongitudinalBaffles.Type
Manufacturer	String		Manufacturer
MaterialComponentCost	Real	Currency	CostData.MaterialComponentCost
MAWPCalculation	Boolean		CalculateMAWP
MAWPHotAndCorroded	Real	Pressure abs	MAWPHotAndCorroded
MAWPNewAndCold	Real	Pressure abs	MAWPNewAndCold
ModelNumber	String		ModelNumber
NormalShellMeanMetalTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).MetalTemperature
NormalShellPressure	Real	Pressure gauge	NormalContents.BulkAmount.Pressure
NormalTubeMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).MetalTemperature
NormalTubePressure	Real	Pressure gauge	NormalContents.BulkAmount.Pressure
NormalTubeSheetMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).MetalTemperature
Notes	String		Notes(*)
NumberOfCrossPasses	Integer		Assemblies.Bundle.NumberOfCrosspasses
NumberOfUnits	Integer		NumberInService
NumberRequired	Integer		NumberRequired
Orientation	String		Orientation
PONumber	String		PoNumber
PressureShellDesignGauge	Real	Pressure gauge	NormalDesignCriteria(1).ShellsideDesign.Pressure
PressureTubeDesignGauge	Real	Pressure gauge	NormalDesignCriteria(1).TubesideDesign.Pressure
ProcessUnit	String		CompleteItemNumber
Profit	Real	Currency	CostData.Profit
QuotedCost	Real	Currency	CostData.QuotedCost
RearEndTemaType	eTemaType(ExchangerE		Assemblies.Ends(2).TemaType
ReasonsForStressRelief	String		InspectionAndTests.ReasonsForStressRelief
RefNameIcarus	String		CostingReference
SealingStripNumberOfPairs	Integer		Assemblies.Bundle.NumberOfSealStrips
SealingStripTubeRowsPer	Real		
ServiceOfUnit	String		Function
ShellAndTubeOnEquipmentSpecification	Boolean		ShellAndTubeOnEquipmentSpecification
ShellAndTubeOnProcessSpecificSS	Boolean		ShellAndTubeOnProcessSpecificSS
ShellBodyFlangeCorrosionAllowance	Real	Length small	Assemblies.ShellSide.BodyFlangeMaterial.CorrosionAllowance
ShellBodyFlangeMaterial	String		Assemblies.ShellSide.BodyFlangeMaterial.MaterialName
ShellCorrosionAllowance	Real	Length Inches	NormalDesignCriteria(1).ShellsideDesign.AllowableCorrosionAllowance
ShellCoverMaterial	String		Assemblies.ShellSide.CoverMaterial.MaterialName
ShellDiameterIncrements	Real		NormalDesignCriteria.ShellsideDesign.ShellDiameterIncrement
ShellDiameterInner	Real	Length	Assemblies.ShellSide.Shell.InnerDiameter
ShellDiameterMaximum	Real	Length small	MaximumDesignCriteria.ShellsideDesign.MaximumShellDiameter
ShellDiameterMinimum	Real	Length small	NormalDesignCriteria(1).ShellsideDesign.AllowableCorrosionAllowance

FIGURE 4f (continued) Structure and attributes of the Composite View for a shell and tube heat exchanger   34 2

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Name	Type	Quantity Type	Route
Composite View 'ShellAndTubeHeatExchanger'			
ShellDiameterMinimum	Real	Length small	NormalDesignCriteria(1).ShellsideDesign.AllowableCorrosionAllowance
ShellDiameterOuter	Real	Length	Assemblies.ShellSide.OuterDiameter
ShellExpansionJoint	String		Assemblies.ShellSide.ExpansionJoints.MaterialOfConstruction.MaterialName
ShellExpansionJointCorrosionAllowance	Real	Length	Assemblies.ShellSide.ExpansionJoints.MaterialOfConstruction.CorrosionAllowance
ShellExternalBoltingCorrosionAllowance	Real	Length small	Assemblies.ShellSide.ExternalBoltingMaterial.CorrosionAllowance
ShellExternalBoltingMaterial	String		Assemblies.ShellSide.ExternalBoltingMaterial.MaterialName
ShellHeadCorrosionAllowance	Real	Length	Assemblies.ShellSide.Shell.Heads(1).MaterialOfConstruction.CorrosionAllowance
ShellHeadMaterial	String		Assemblies.ShellSide.Shell.Heads(1).MaterialOfConstruction.MaterialName
ShellInternalBoltingCorrosionAllowance	Real	Length small	Assemblies.ShellSide.InternalBoltingMaterial.CorrosionAllowance
ShellInternalBoltingMaterial	String		Assemblies.ShellSide.InternalBoltingMaterial.MaterialName
ShellMaterial	String		Assemblies.ShellSide.Shell.MaterialOfConstruction.MaterialName
ShellMaterialClass	String		Assemblies.ShellSide.MaterialOfConstruction.MaterialClass
ShellNozzleFlangeCorrosionAllowance	Real	Length small	Assemblies.ShellSide.NozzleFlangeMaterial.CorrosionAllowance
ShellNozzleFlangeMaterial	String		Assemblies.ShellSide.NozzleFlangeMaterial.MaterialName
ShellNozzleNeckMaterial	String		Assemblies.ShellSide.NozzleNeckMaterial.MaterialName
ShellNozzleNecksCorrosionAllowance	Real	Length small	Assemblies.ShellSide.NozzleNeckMaterial.CorrosionAllowance
ShellNozzleReinforcementCorrosionAllowance	Real	Length	Assemblies.ShellSide.Shell.Nozzles(1).MaterialOfConstruction.CorrosionAllowance
ShellNozzleReinforcementMaterial	String		Assemblies.ShellSide.Shell.Nozzles(1).Reinforced
ShellPassesNumberPerShell	Integer		Assemblies.ShellSide.NumberShellPasses
ShellPipeandStubEndCorrosionAllowance	Real	Length small	Assemblies.ShellSide.PipeAndStubEndMaterial.CorrosionAllowance
ShellPipeandStubEndMaterial	String		Assemblies.ShellSide.PipeAndStubEndMaterial.MaterialName
ShellSideAverageFilmCoefficient	Real	Heat Transfer Coef	Assemblies.PerformanceCriteria.ShellsidePerformance.BulkFilmCoefficient
ShellSideCleaning	String		Assemblies.ShellSide.MechanicalCleaning
ShellSideCorrosionAllowance	Real	Length	Assemblies.ShellSide.MaterialOfConstruction.CorrosionAllowance
ShellSideCrossflowFraction	Real	Fraction	
ShellSideDesignPressure	Real	Pressure gauge	Assemblies.ShellSide.NormalDesignCriteria(1).Pressure
ShellSideDesignPressureMaximum	Real	Pressure abs	Assemblies.ShellSide.MaximumDesignCriteria.Pressure
ShellSideDesignTemperature	Real	Temperature	Assemblies.ShellSide.NormalDesignCriteria(1).Temperature
ShellSideDesignTemperatureMaximum	Real	Temperature tmp	Assemblies.ShellSide.MaximumDesignCriteria.Temperature
ShellSideDrainNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="Drain"].Number
ShellSideDrainNozzleRating	eNozzleRating2_PIP VEC		Assemblies.ShellSide.Nozzles[NozzleFunction="Drain"].Rating
ShellSideDrainNozzleSize	Real	Length	Assemblies.ShellSide.Nozzles[NozzleFunction="Drain"].NominalSize
ShellSideFluidName	String		MaterialPorts[PhysicalAllocation=ShellIn].Flow.Name
ShellSideFoulingCoefficient	Real	Heat Transfer Coef	Assemblies.PerformanceCriteria.ShellsidePerformance.FoulingCoefficient
ShellSideFoulingResistance	Real	Thermal Resistance	Assemblies.PerformanceCriteria.ShellsidePerformance.FoulingResistance
ShellSideGasketMaintenanceFactor	Real	Pressure abs	Assemblies.ShellSide.Gasket.MaintenanceFactor
ShellSideGasketMaterial	String		Assemblies.Gasket.MaterialOfConstruction.MaterialName
ShellSideGasketThickness	Real	Length small	Assemblies.ShellSide.Gasket.BodyMaterial.Thickness
ShellSideGasketYFactor	Real	Pressure abs	Assemblies.ShellSide.Gasket.MinimumDesignSeatingStress
ShellSideInletNozzleInsideDiameter	Real	Length small	Assemblies.ShellSide.Nozzles[NozzleFunction="Inlet"].Bore
ShellSideInletNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="Inlet"].Number
ShellSideInletNozzleRating	eNozzleRating1_PIP VEC		Assemblies.ShellSide.Nozzles[NozzleFunction="Inlet"].Rating
ShellSideInletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.ShellSide.Nozzles[NozzleFunction="Inlet"].RhoV2
ShellSideInletNozzleSize	Real	Length	Assemblies.ShellSide.Nozzles[NozzleFunction="Inlet"].NominalSize
ShellSideInletNozzleType	String		Assemblies.ShellSide.Nozzles[NozzleFunction="Inlet"].Type
ShellSideInletPressure	Real	Pressure abs	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.BulkFlow.Pressure
ShellSideInletTemperature	Real	Temperature tmp	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.BulkFlow.Temperature
ShellSideIntermediateNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="Intermediate"].Number
ShellSideIntermediateNozzleRating	eNozzleRating1_PIP VEC		Assemblies.ShellSide.Nozzles[NozzleFunction="Intermediate"].Rating
ShellSideIntermediateNozzleRhoV2	Real	Density Velocity Sq	Assemblies.ShellSide.Nozzles[NozzleFunction="Intermediate"].RhoV2
ShellSideIntermediateNozzleSize	Real	Length	Assemblies.ShellSide.Nozzles[NozzleFunction="Intermediate"].NominalSize
ShellSideIntermediateNozzleType	String		Assemblies.ShellSide.Nozzles[NozzleFunction="Intermediate"].Type
ShellSideLatentHeat	Real	Latent heat normal	MaterialPort[PhysicalAllocation="ShellIn"].Flow.BulkFlow.ThermodynamicProperties.HeatOfVapor

FIGURE 4q (continued) Structure and attributes of the Composite View for a shell and tube heat exchanger

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Composite View 'ShellAndTubeHeatExchanger'			_|□|×|
Name	**Type**	**Quantity Type**	**Route**
ShellSideLatentHeat	Real	Latent heat normal	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.BulkFlow.ThermodynamicProperties.HeatOfVapor
ShellSideLatentHeatReferenceTemperature	Real	Temperature	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.BulkFlow.TransportProperties.ReferenceTemper
ShellSideLiquidInletDensity	Real	Density	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Liquid1Phase.PvtProperties.DensityMassBasis
ShellSideLiquidInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Liquid1Phase.MassFlowRate
ShellSideLiquidInletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Liquid1Phase.ThermodynamicProperties.HeatCap
ShellSideLiquidInletSurfaceTension	Real	Surface Tension	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Liquid1Phase.TransportProperties.SurfaceTensio
ShellSideLiquidInletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Liquid1Phase.TransportProperties.ThermalCondu
ShellSideLiquidInletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Liquid1Phase.TransportProperties.Viscosity
ShellSideLiquidOutletDensity	Real	Density	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Liquid1Phase.PvtProperties.DensityMassBasis
ShellSideLiquidOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Liquid1Phase.MassFlowRate
ShellSideLiquidOutletNozzleInsideDiameter	Real	Length small	Assemblies.ShellSide.Nozzles[NozzleFunction="LiquidOutlet"].Bore
ShellSideLiquidOutletNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="LiquidOutlet"].Number
ShellSideLiquidOutletNozzleRating	eNozzleRating1_PIP VEC		Assemblies.ShellSide.Nozzles[NozzleFunction="LiquidOutlet"].Rating
ShellSideLiquidOutletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.ShellSide.Nozzles[NozzleFunction="LiquidOutlet"].RhoV2
ShellSideLiquidOutletNozzleType	String		Assemblies.ShellSide.Nozzles[NozzleFunction="LiquidOutlet"].Type
ShellSideLiquidOutletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Liquid1Phase.ThermodynamicProperties.HeatC.
ShellSideLiquidOutletSurafceTension	Real	Surface tension PQ	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Liquid1Phase.TransportProperties.SurfaceTens
ShellSideLiquidOutletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Liquid1Phase.TransportProperties.ThermalCon
ShellSideLiquidOutletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Liquid1Phase.TransportProperties.Viscosity
ShellSideMinimumDesignMetalTemperature	Real	Temperature	Assemblies.ShellSide.MinimumDesignCriteria(1).MetalTemperature
ShellSideNoncondensableInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.NonCondensibles.MassFlowRate
ShellSideNoncondensableInletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.NonCondensibles.MolecularWeight
ShellSideNoncondensableOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.NonCondensibles.MassFlowRate
ShellSideNoncondensableOutletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.NonCondensibles.PvtProperties.MolecularWeigl
ShellSideNumberOfPassesPerShell	Integer		Assemblies.ShellSide.NumberOfPasses
ShellSideOutletNozzleInsideDiameter	Real	Length small	Assemblies.ShellSide.Nozzles[NozzleFunction="Outlet"].Bore
ShellSideOutletNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="Outlet"].Number
ShellSideOutletNozzleRating	eNozzleRating1_PIP VEC		Assemblies.ShellSide.Nozzles[NozzleFunction="Outlet"].Rating
ShellSideOutletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.ShellSide.Nozzles[NozzleFunction="Outlet"].RhoV2
ShellSideOutletNozzleSize	Real	Length	Assemblies.ShellSide.Nozzles[NozzleFunction="Outlet"].NominalSize
ShellSideOutletNozzleType	String		Assemblies.ShellSide.Nozzles[NozzleFunction="Outlet"].Type
ShellSideOutletTemperature	Real	Temperature tmp	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.BulkFlow.Temperature
ShellSidePressureDropAllowable	Real	Pressure Diff	Assemblies.ShellSide.NormalOperatingCriteria(1).PressureDrop
ShellSidePressureDropCalculated	Real	Pressure Diff	Assemblies.ShellSide.NormalOperatingCriteria(2).PressureDrop
ShellSideSteamInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.Steam.MassFlowRate
ShellSideSteamOutletFlow	Real	Mass flow normal	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.Steam.MassFlowRate
ShellSideTestPressure	Real	Pressure abs	Assemblies.ShellSide.InspectionAndTests.HydrostaticTestPressure
ShellSideTotalFluidQuantity	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.BulkFlow.MassFlowRate
ShellSideVaporInletDensity	Real	Density	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.VapourPhase.PvtProperties.DensityMassBasis
ShellSideVaporInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.VapourPhase.MassFlowRate
ShellSideVaporInletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.VapourPhase.MolecularWeight
ShellSideVaporInletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.VapourPhase.ThermodynamicProperties.HeatCap
ShellSideVaporInletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.VapourPhase.TransportProperties.ThermalCondu
ShellSideVaporInletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.VapourPhase.TransportProperties.Viscosity
ShellSideVaporOutletDensity	Real	Density	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.PvtProperties.DensityMassBasis
ShellSideVaporOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.MassFlowRate
ShellSideVaporOutletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.PvtProperties.MolecularWeight
ShellSideVaporOutletNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="VaporOutlet"].Number
ShellSideVaporOutletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.ShellSide.Nozzles[NozzleFunction="VaporOutlet"].RhoV2
ShellSideVaporOutletNozzleSize	Real	Length small	Assemblies.ShellSide.Nozzles[NozzleFunction="VaporOutlet"].NominalSize
ShellSideVaporOutletNozzleType	String		Assemblies.ShellSide.Nozzles[NozzleFunction="VaporOutlet"].Type
ShellSideVaporOutletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.ThermodynamicProperties.HeatC
ShellSideVaporOutletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.TransportProperties.ThermalCon

FIGURE 4h(continued) Structure and attributes of the Composite View for a shell and tube heat exchanger

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Name	Type	Quantity Type	Route
ShellSideVaporOutletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.TransportProperties.ThermalCon
ShellSideVaporOutletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.VapourPhase.TransportProperties.Viscosity
ShellSideVelocity	Real	Velocity	Assemblies.PerformanceCriteria.ShellsidePerformance.MidpointVelocity
ShellSideVelocityMaximum	Real	Velocity small	Assemblies.NormalDesignCriteria.ShellsideDesign.MaximumVelocity
ShellSideVentNozzleNumber	Integer		Assemblies.ShellSide.Nozzles[NozzleFunction="Vent"].Number
ShellSideVentNozzleRating	eNozzleRating2_PIP VEI		Assemblies.ShellSide.Nozzles[NozzleFunction="Vent"].Rating
ShellSideVentNozzleSize	Real	Length	Assemblies.ShellSide.Nozzles[NozzleFunction="Vent"].NominalSize
ShellSideWaterInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellIn"].Flow.CoolingWater.MassFlowRate
ShellSideWaterOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="ShellOut"].Flow.CoolingWater.MassFlowRate
ShellsInParallelMaximum	Integer		NormalDesignCriteria(1).MaximumShellsInParallel
ShellsInParallelMinimum	Integer		NormalDesignCriteria(1).MinimumShellsInParallel
ShellsInParallelNumber	Integer		NumberShellsInParallel
ShellsInSeriesMaximum	Integer		NormalDesignCriteria(1).MaximumShellsInSeries
ShellsInSeriesMinimum	Integer		NormalDesignCriteria(1).MinimumShellsInSeries
ShellsInSeriesNumber	Integer		NumberShellsInSeries
ShellIsMultiple	Boolean		MultipleShells
Shellsperunit	Integer		NumberShellsPerUnit
ShellSupportsCorrosionAllowance	Real	Length small	Assemblies.ShellSide.Shell.Support.MaterialOfConstruction.CorrosionAllowance
ShellSupportsMaterial	String		Assemblies.ShellSide.Shell.Support.MaterialOfConstruction.MaterialName
ShellTEMAType	eShellTEMAType		Assemblies.ShellSide.TemaShellType
ShellThickness	Real	Length small	Assemblies.ShellSide.Shell.Thickness
ShellThicknessMinimum	Real	Length	
ShopManpowerCost	Real	Currency	CostData.ShopManpowerCost
ShopOverhead	Real	Currency	CostData.ShopOverhead
ShutdownShellMeanMetalTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).MetalTemperature
ShutdownShellPressure	Real	Pressure gauge	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).Pressure
ShutdownTubeMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).MetalTemperature
ShutdownTubePressure	Real	Pressure gauge	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).Pressure
ShutdownTubeSheetMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.Tubesheets(1).NormalDesignCriteria(1).MetalTemperature
StartupShellMeanMetalTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).MetalTemperature
StartupShellPressure	Real	Pressure gauge	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).Pressure
StartupTubeMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).MetalTemperature
StartupTubePressure	Real	Pressure gauge	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).Pressure
StartupTubeSheetMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.Tubesheets(1).NormalDesignCriteria(1).MetalTemperature
Status	String		Status
SteamOutShellMeanMetalTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).SteamOutTemperature
SteamOutShellPressure	Real	Pressure gauge	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).SteamOutPressure
SteamOutShellRequirement	Boolean		Assemblies.ShellSide.Shell.NormalDesignCriteria.SteamOutRequirement
SteamOutTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria.SteamOutTemperature
SteamOutTubeMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).SteamOutTemperature
SteamOutTubePressure	Real	Pressure gauge	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).SteamOutPressure
SteamOutTubeSheetMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.Tubesheets(1).NormalDesignCriteria(1).SteamOutTemperature
SurfaceExcessMinimum	Real	Area normal	
SurfacePerShellEffective	Real	Area normal	Assemblies.ShellSide.EffectiveArea
SurfacePerUnitEffective	Real	Area	EffectiveSurfacePerUnit
SurfacePerUnitRequired	Real	Area normal	RequiredSurfacePerUnit
TEMAClass	eTemaClass(ShellAndTul		TEMAClass
TEMAOrientation	eTemaOrientation_PIP \		TEMAOrientation
TEMARemarks	String		TEMARemarks
TEMASize	String		Size
TEMAType	String		Type
TemperatureShellDesign	Real	Temperature tmf	NormalDesignCriteria(1).ShellsideDesign.Temperature
TemperatureTubeDesign	Real	Temperature tmf	NormalDesignCriteria(1).TubesideDesign.Temperature

FIGURE 4*i* (continued) Structure and attributes of the Composite View for a shell and tube heat exchanger   *3 4 7*

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Composite View 'ShellAndTubeHeatExchanger'   — |□| x|

Name	Type	Quantity Type	Route
TemperatureTubeDesign	Real	Temperature tmf	NormalDesignCriteria(1).TubesideDesign.Temperature
TerminalStreams	MaterialFlowSpecification		MaterialPorts(*).PipingSystem
TestRingRequired	Boolean		InspectionAndTests.TestRingRequired
ThicknessShell	Real	Length small	Assemblies.ShellSide.Thickness
TotalCost	Real	Currency	CostData.TotalCost
TubeBaffleDiametralClearance	Real	Length normal	Assemblies.Bundle.TubeToBaffleClearance
TubeBWGAverage	Integer		Assemblies.Bundle.TubeType(1).BirminghamWireGauge
TubeBWGMinimum	Integer		Assemblies.Bundle.TubeType(1).BirminhamWireGaugeMinimum
TubeCorrosionAllowance	Real	Length Inches	NormalDesignCriteria(1).TubesideDesign.AllowableCorrosionAllowance
TubeFinDiameterOuter	Real	Length normal	Assemblies.Bundle.TubeType(1).Externals.OuterDiameter
TubeFinDiameterRoot	Real	Length normal	Assemblies.Bundle.TubeType(1).Externals.RootDiameter
TubeFinHeight	Real	Length normal	Assemblies.Bundle.TubeType(1).Externals.Height
TubeFinMaterial	String		Assemblies.Bundle.TubeType(1).Externals.MaterialOfConstruction.MaterialName
TubeFinPerUnitLength	Real	Inverse length	Assemblies.Bundle.TubeType(1).Externals.NumberOfFinsPerUnitLength
TubeFinPitch	Real	Length normal	Assemblies.Bundle.TubeType(1).Externals.FinPitch
TubeFinThickness	Real	Length normal	Assemblies.Bundle.TubeType(1).Externals.AverageThickness
TubeInletEndlength	Real	Length normal	Assemblies.Bundle.TubeType(1).InletEndlength
TubeInnerDiameter	Real	Length small	Assemblies.Bundle.TubeType(1).InnerDiameter
TubeLayout	eTubeLayout(Exchanger		Assemblies.Bundle.TubeLayout
TubeLayoutAlternate	eTubeLayout(Exchanger		Assemblies.Bundle.TubeLayoutAlternate
TubeLayoutSpec	eTubeLayout(Exchanger	.	Assemblies.Bundle.TubeLayoutSpec
TubeLength	Real	Length	Assemblies.Bundle.TubeType(1).TotalLength
TubeLengthIncrement	Real	Length small	NormalDesignCriteria(1).TubesideDesign.TubeLengthIncrement
TubeLengthMaximum	Real	Length small	NormalDesignCriteria(1).TubesideDesign.MaximumTubeLength
TubeLengthMinimum	Real	Length small	NormalDesignCriteria(1).TubesideDesign.MinimumTubeLength
TubeLengthStraight	Real	Length normal	Assemblies.Bundle.TubeType(1).StraightLength
TubeLengthUnfinnedAtBaffles	Real	Length	
TubeMaterial	String		Assemblies.Bundle.TubeType(1).MaterialOfConstruction.MaterialName
TubeMaterialClass	String		Assemblies.Bundle.TubeType(1).MaterialOfConstruction.MaterialClass
TubeMaterialDensity	Real	Density	Assemblies.Bundle.TubeType(1).MaterialOfConstruction.Density
TubeNumber	Integer		Assemblies.Bundle.TotalNumberOfTubes
TubeOuterDiameter	Real	Length	Assemblies.Bundle.TubeType(1).OuterDiameter
TubeOuterDiameterAlternate	Real	Length small	Assemblies.Bundle.TubeType(1).OuterDiameterAlternate
TubeOutletEndlength	Real	Length normal	Assemblies.Bundle.TubeType(1).OutletEndlength
TubePassesIncrement	String		
TubePassesNumberPerShell	Integer		Assemblies.Bundle.NumberTubePassesPerShell
TubePassesNumberPerShellMaximum	Real		
TubePassesNumberPerShellMinimum	Real		
TubePitch	Real	Length	Assemblies.Bundle.TubePitch
TubePitchAlternate	Real	Length normal	Assemblies.Bundle.TubePitchAlternate
TubesCorrosionAllowance	Real	Length small	Assemblies.Bundle.TubeType(1).MaterialOfConstruction.CorrosionAllowance
TubeSheetFloatingMaterial	String		Assemblies.Bundle.Tubesheets(2).MaterialOfConstruction.MaterialName
TubeSheetsCorrosionAllowance	Real	Length	Assemblies.Bundle.Tubesheets(1).MaterialOfConstruction.CorrosionAllowance
TubeSheetsMaterial	String		Assemblies.Bundle.Tubesheets(1).MaterialOfConstruction.MaterialName
TubeSheetThickness	Real	Length	Assemblies.Bundle.Tubesheets(1).MaterialOfConstruction.Thickness
TubeSideAverageFilmCoefficient	Real	Heat Transfer Coef	Assemblies.PerformanceCriteria.TubesidePerformance.BulkFilmCoefficient
TubeSideCleaning	String		Assemblies.Bundle.MechanicalCleaning
TubeSideCorrosionAllowance	Real	Length	Assemblies.Bundle.TubeType(1).MaterialOfConstruction.CorrosionAllowance
TubeSideDesignPressure	Real	Pressure abs	Assemblies.Bundle.NormalDesignCriteria(1).Pressure
TubeSideDesignPressureMaximum	Real	Pressure abs	Assemblies.Bundle.MaximumDesignCriteria.Pressure
TubeSideDesignTemperature	Real	Temperature tmp	Assemblies.Bundle.NormalDesignCriteria(1).Temperature
TubeSideDesignTemperatureMaximum	Real	Temperature tmp	Assemblies.Bundle.MaximumDesignCriteria.Temperature
TubeSideDrainNozzleNumber	Integer		Assemblies.Bundle.Nozzles(NozzleFunction="Drain").Number

FIGURE 4 (continued) Structure and attributes of the Composite View for a shell and tube heat exchanger 342

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Name	Type	Quantity Type	Route
Composite View 'ShellAndTubeHeatExchanger'			
TubeSideDrainNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="Drain"].Number
TubeSideDrainNozzleRating	eNozzleRating2_PIP VEC		Assemblies.Bundle.Nozzles[NozzleFunction="Drain"].Rating
TubeSideDrainNozzleSize	Real	Length	Assemblies.Bundle.Nozzles[NozzleFunction="Drain"].NominalSize
TubeSideFluidName	String		MaterialPorts[PhysicalAllocation=TubeIn].Flow.Name
TubeSideFoulingCoefficient	Real	Heat Transfer Coef	Assemblies.PerformanceCriteria.TubesidePerformance.FoulingCoefficient
TubeSideFoulingResistance	Real	Thermal Resistance	Assemblies.PerformanceCriteria.TubesidePerformance.FoulingResistance
TubeSideGasketMaintenanceFactor	Real	Pressure abs	Assemblies.Bundle.Gasket.MaintenanceFactor
TubeSideGasketMaterial	String		Assemblies.Bundle.Gasket.BodyMaterial.MaterialName
TubeSideGasketThickness	Real	Length small	Assemblies.Bundle.Gasket.BodyMaterial.Thickness
TubeSideGasketYFactor	Real	Pressure abs	Assemblies.Bundle.Gasket.MinimumDesignSeatingStress
TubesideInletNozzleAngularPosition	Real	Plane Angle	—
TubeSideInletNozzleDistanceFromTubesheet	Real	Length	
TubeSideInletNozzleInsideDiameter	Real	Length small	Assemblies.Bundle.Nozzles[NozzleFunction="Inlet"].Bore
TubeSideInletNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="Inlet"].Number
TubeSideInletNozzlePressureDrop	Real	Pressure	
TubeSideInletNozzleRating	eNozzleRating1_PIP VEC		Assemblies.Bundle.Nozzles[NozzleFunction="Inlet"].Rating
TubeSideInletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].RhoV2
TubeSideInletNozzleSize	Real	Length	Assemblies.Bundle.Nozzles[NozzleFunction="Inlet"].NominalSize
TubeSideInletNozzleType	String		Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].Type
TubeSideInletNozzleWallThickness	Real	Length	
TubeSideInletPressure	Real	Pressure abs	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.BulkFlow.Pressure
TubeSideInletTemperature	Real	Temperature tmp	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.BulkFlow.Temperature
TubeSideIntermediateNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].Number
TubeSideIntermediateNozzleRating	eNozzleRating1_PIP VEC		Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].Rating
TubeSideIntermediateNozzleRhoV2	Real	Density Velocity Sq	Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].RhoV2
TubeSideIntermediateNozzleSize	Real	Length	Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].NominalSize
TubeSideIntermediateNozzleType	String		Assemblies.Bundle.Nozzles[NozzleFunction="Intermediate"].Type
TubeSideLatentHeat	Real	Latent heat normal	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.BulkFlow.ThermodynamicProperties.HeatOfVapo
TubeSideLatentHeatReferenceTemperature	Real	Temperature	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.TransportProperties.ReferenceTemper
TubeSideLiquidInletDensity	Real	Density	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.Liquid1Phase.PvtProperties.DensityMassBasis
TubeSideLiquidInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.Liquid1Phase.MassFlowRate
TubeSideLiquidInletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.Liquid1Phase.ThermodynamicProperties.HeatCaj
TubeSideLiquidInletSurfaceTension	Real	Surface Tension	
TubeSideLiquidInletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.Liquid1Phase.TransportProperties.ThermalCondu
TubeSideLiquidInletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.Liquid1Phase.TransportProperties.Viscosity
TubeSideLiquidOutletDensity	Real	Density	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.Liquid1Phase.PvtProperties.DensityMassBasis
TubeSideLiquidOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.Liquid1Phase.MassFlowRate
TubeSideLiquidOutletNozzleInsideDiameter	Real	Length small	Assemblies.Bundle.Nozzles[NozzleFunction="LiquidOutlet"].Bore
TubeSideLiquidOutletNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="LiquidOutlet"].Number
TubeSideLiquidOutletNozzleRating	eNozzleRating1_PIP VEC		Assemblies.Bundle.Nozzles[NozzleFunction="LiquidOutlet"].Rating
TubeSideLiquidOutletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.Bundle.Nozzles[NozzleFunction="LiquidOutlet"].RhoV2
TubeSideLiquidOutletNozzleSize	Real	Length small	Assemblies.Bundle.Nozzles[NozzleFunction="LiquidOutlet"].NominalSize
TubeSideLiquidOutletNozzleType	String		Assemblies.Bundle.Nozzles[NozzleFunction="LiquidOutlet"].Type
TubeSideLiquidOutletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.Liquid1Phase.ThermodynamicProperties.HeatC
TubeSideLiquidOutletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.Liquid1Phase.TransportProperties.ThermalCon
TubeSideLiquidOutletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.Liquid1Phase.TransportProperties.Viscosity
TubeSideMinimumDesignMetalTemperature	Real	Temperature	MinimumDesignCriteria(1).MetalTemperature
TubeSideNoncondensableInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.NonCondensibles.MassFlowRate
TubeSideNoncondensableInletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.NonCondensibles.MolecularWeight
TubeSideNoncondensableOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.NonCondensibles.MassFlowRate
TubeSideNoncondensableOutletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.NonCondensibles.MolecularWeight
TubeSideOutletNozzleInsideDiameter	Real	Length	Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].Bore
TubeSideOutletNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].Number

FIGURE 4K(continued) Structure and attributes of the Composite View for a shell and tube heat exchanger   34 7

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Composite View 'ShellAndTubeHeatExchanger'			_|□|x|
Name	Type	Quantity Type	Route
TubeSideOutletNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].Number
TubeSideOutletNozzleRating	eNozzleRating1_PIP VEC		Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].Rating
TubeSideOutletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].RhoV2
TubeSideOutletNozzleSize	Real	Length	Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].NominalSize
TubeSideOutletNozzleType	String		Assemblies.Bundle.Nozzles[NozzleFunction="Outlet"].Type
TubeSideOutletSurfaceTension	Real	Surface Tension	
TubeSideOutletTemperature	Real	Temperature tmp	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.BulkFlow.Temperature
TubesidePassesMaximum	Real		
TubesidePassesMinimum	Real		
TubeSidePassesNumberPerShell	Integer		NumberTubePasses
TubeSidePressureDropAllowable	Real	Pressure Diff	Assemblies.Bundle.NormalDesignCriteria.PressureDrop
TubeSidePressureDropCalculated	Real	Pressure Diff	Assemblies.Bundle.NormalOperatingCriteria.PressureDrop
TubeSideSteamInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.Steam.MassFlowRate
TubeSideSteamOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.Steam.MassFlowRate
TubeSideTestPressure	Real	Pressure abs	Assemblies.Bundle.InspectionAndTests.HydrostaticTestPressure
TubeSideTotalFluidQuantity	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.BulkFlow.MassFlowRate
TubeSideVaporInletDensity	Real	Density	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.VapourPhase.PvtProperties.DensityMassBasis
TubeSideVaporInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.VapourPhase.MassFlowRate
TubeSideVaporInletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.VapourPhase.MolecularWeight
TubeSideVaporInletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.VapourPhase.ThermodynamicProperties.HeatCa
TubeSideVaporInletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.VapourPhase.TransportProperties.ThermalCond
TubeSideVaporInletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.VapourPhase.TransportProperties.Viscosity
TubeSideVaporOutletDensity	Real	Density	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.VapourPhase.PvtProperties.DensityMassBasis
TubeSideVaporOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.VapourPhase.MassFlowRate
TubeSideVaporOutletMw	Real	Molar Mass	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.VapourPhase.MolecularWeight
TubeSideVaporOutletNozzleRhoV2	Real	Density Velocity Sq	Assemblies.Bundle.Nozzles[NozzleFunction="VaporOutlet"].RhoV2
TubeSideVaporOutletNozzleSize	Real	Length small	Assemblies.Bundle.Nozzles[NozzleFunction="VaporOutlet"].NominalSize
TubeSideVaporOutletNozzleType	String		Assemblies.Bundle.Nozzles[NozzleFunction="VaporOutlet"].Type
TubeSideVaporOutletSpecificHeat	Real	Spec Heat Cap (Ma	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.VapourPhase.ThermodynamicProperties.HeatC
TubeSideVaporOutletThermalConductivity	Real	Thermal Conductivi	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.VapourPhase.TransportProperties.ThermalCon
TubeSideVaporOutletViscosity	Real	Dynamic Viscosity	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.VapourPhase.TransportProperties.Viscosity
TubeSideVelocity	Real	Velocity	Assemblies.PerformanceCriteria.TubesidePerformance.MidpointVelocity
TubeSideVentNozzleNumber	Integer		Assemblies.Bundle.Nozzles[NozzleFunction="Vent"].Number
TubeSideVentNozzleRating	eNozzleRating2_PIP VEC		Assemblies.Bundle.Nozzles[NozzleFunction="Vent"].Rating
TubeSideVentNozzleSize	Real	Length	Assemblies.Bundle.Nozzles[NozzleFunction="Vent"].NominalSize
TubeSideWaterInletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeIn"].Flow.CoolingWater.MassFlowRate
TubeSideWaterOutletFlow	Real	Flow Rate (Mass)	MaterialPorts[PhysicalAllocation="TubeOut"].Flow.CoolingWater.MassFlowRate
TubesInWindowNumberOf	Real		
TubeSlope	Real	Plane Angle	Assemblies.Bundle.Slope
TubeSupport	String		Assemblies.Bundle.BundleSupport.Type
TubeThermalConductivity	Real	Thermal Conductivi	Assemblies.Bundle.TubeType(1).MaterialOfConstruction.ThermalConductivity
TubeThickness	Real	Length	Assemblies.Bundle.TubeType(1).WallThickness
TubeThicknessAlternate	Real	Length small	Assemblies.Bundle.TubeType(1).WallThicknessAlternate
TubeThicknessUnderFins	Real	Length small	
TubeToTubesheetJoint	eTubeToTubesheetJoint		Assemblies.Bundle.Tubesheets(1).TubeToTubesheetJoint
TubeType	eType(ExchangerTube)		Assemblies.Bundle.TubeType(1).TubeType
TubeYoungsModulus	Real	Stress	Assemblies.Bundle.TubeType(1).MaterialOfConstruction.ElasticModulus
UBendRadius	Real	Length small	
UBendSupportDescription	String		Assemblies.Bundle.UBendSupport.Description
UBendSupportType	eType(UBendSupport)		Assemblies.Bundle.UBendSupport.SupportType
Upset1ShellMeanMetalTemperature	Real	Temperature	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).MetalTemperature
Upset1ShellPressure	Real	Pressure gauge	Assemblies.ShellSide.Shell.NormalDesignCriteria(1).Pressure
Upset1TubeMeanMetalTemperature	Real	Temperature	Assemblies.Bundle.TubeType(1).NormalDesignCriteria(1).MetalTemperature

FIGURE 5a Structure and attributes of part of a typical Equipment Datasheet Class View for a shell and tube heat exchanger   38 ⟩   39

Class View 'PIP VEDST003'

Name	Type	Quantity Type	Link
⊞ N DatasheetObjectHeader	DatasheetObjectl		
⊟ N Page1			
⊞ N HeaderData			
⊟ N PerformanceOfOneUnit			
⊟ N ShellSide			
A FluidName	String		ShellAndTubeHeatExchanger.ShellSideFluidName
A TotalFluidQuantity	Real	Flow Rate (kg/h)	ShellAndTubeHeatExchanger.ShellSideTotalFluidQuantity
⊞ N FlowRate			
⊞ N MolecularWeight			
A InletTemperature	Real	Temperature (C)	ShellAndTubeHeatExchanger.ShellSideInletTemperature
A OutletTemperature	Real	Temperature (C)	ShellAndTubeHeatExchanger.ShellSideOutletTemperature
⊞ N Density			
⊞ N Viscosity			
⊞ N SpecificHeat			
⊞ N ThermalConductivity			
A LatentHeat	Real	Calorific Val (kJ/kg)	ShellAndTubeHeatExchanger.ShellSideLatentHeat
A LatentHeatReferenceTemperature	Real	Temperature (C)	ShellAndTubeHeatExchanger.ShellSideLatentHeatReferenceTemperature
A InletPressure	Real	Pressure Absolute	ShellAndTubeHeatExchanger.ShellSideInletPressure
A Velocity	Real	Velocity (m/s)	ShellAndTubeHeatExchanger.ShellSideVelocity
A AllowablePressureDrop	Real	Pressure Diff (Mpa)	ShellAndTubeHeatExchanger.ShellSidePressureDropAllowable
A CalculatedPressureDrop	Real	Pressure Diff (Mpa)	ShellAndTubeHeatExchanger.ShellSidePressureDropCalculated
A FoulingResistance	Real	Fouling Resistance	ShellAndTubeHeatExchanger.ShellSideFoulingResistance
A AverageFilmCoefficient	Real	Heat Transfer Coef	ShellAndTubeHeatExchanger.ShellSideAverageFilmCoefficient
⊟ N TubeSide			
A FluidName	String		ShellAndTubeHeatExchanger.TubeSideFluidName
A TotalFluidQuantity	Real	Flow Rate (kg/h)	ShellAndTubeHeatExchanger.TubeSideTotalFluidQuantity
⊞ N FlowRate			
⊟ N MolecularWeight			
A VaporInletMw	Real	Molar Mass	ShellAndTubeHeatExchanger.TubeSideVaporInletMw
A VaporOutletMw	Real	Molar Mass	ShellAndTubeHeatExchanger.TubeSideVaporOutletMw
A NoncondensableInletMw	Real	Molar Mass	ShellAndTubeHeatExchanger.TubeSideNoncondensableInletMw
A NoncondensableOutletMw	Real	Molar Mass	ShellAndTubeHeatExchanger.TubeSideNoncondensableOutletMw
A InletTemperature	Real	Temperature (C)	ShellAndTubeHeatExchanger.TubeSideInletTemperature
A OutletTemperature	Real	Temperature (C)	ShellAndTubeHeatExchanger.TubeSideOutletTemperature
⊟ N Density			
A VaporInletDensity	Real	Density	ShellAndTubeHeatExchanger.TubeSideVaporInletDensity
A LiquidInletDensity	Real	Density	ShellAndTubeHeatExchanger.TubeSideLiquidInletDensity
A VaporOutletDensity	Real	Density	ShellAndTubeHeatExchanger.TubeSideVaporOutletDensity
A LiquidOutletDensity	Real	Density	ShellAndTubeHeatExchanger.TubeSideLiquidOutletDensity
⊞ N Viscosity			
⊞ N SpecificHeat			
⊞ N ThermalConductivity			
A LatentHeat	Real	Calorific Val (kJ/kg)	ShellAndTubeHeatExchanger.TubeSideLatentHeat
A LatentHeatReferenceTemperature	Real	Temperature (C)	ShellAndTubeHeatExchanger.TubeSideLatentHeatReferenceTemperature
A InletPressure	Real	Pressure Absolute	ShellAndTubeHeatExchanger.TubeSideInletPressure
A Velocity	Real	Velocity (m/s)	ShellAndTubeHeatExchanger.TubeSideVelocity

Figure 5b Structure and attributes of part of a typical Heat Exchanger Design Program Class View for a shell and tube heat exchanger 3 7 7   35

Class View 'HetranExchangerInput'   _ |□| x|

Name	Type	Quantity Type	Link
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
A INDEX	String		ShellAndTubeHeatExchanger.ItemNumber
N ProblemDefinition			
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
N Description			
N ApplicationOptions			
N ProcessData			
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
N ProcessDataTab			
N HeatLoadBalanceOptions			
N PhysicalPropertyData			
N ExchangerGeometry			
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
N Exchanger			
N Tubes			
N Bundle			
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
N ShellInletOutlet			
N Impingement			
A IMPPROTTYPE	eHetranImpProtType		ShellAndTubeHeatExchanger.ImpingementProtectionType
N LayoutOptions			
N LayoutLimits			
N Clearances			
N Baffles			
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
N BafflesTab			
A BAFTYPE	eHetranBafType		
A BAFCUTPERC	Real	Percentage PQT	ShellAndTubeHeatExchanger.BaffleCut
A BAFORIE	String		ShellAndTubeHeatExchanger.BaffleCutOrientation
N TubeSupports			
N RatingSimulationData			
A DBNAME	String		ShellAndTubeHeatExchanger.ItemNumber
N RatingSimulationGeometry			
A SHLID	Real	Length small	ShellAndTubeHeatExchanger.ShellDiameterInner
A SHLOD	Real	Length small	ShellAndTubeHeatExchanger.ShellDiameterOuter
A BAFSPCCC	Real	Length small	ShellAndTubeHeatExchanger.BaffleSpacing
A BAFSPCIN	Real	Length small	ShellAndTubeHeatExchanger.BaffleSpacingFromInlet
A BAFSPCOUT	Real	Length small	ShellAndTubeHeatExchanger.BaffleSpacingFromOutlet
A BAFNUM	Integer		ShellAndTubeHeatExchanger.BafflesNumber
A TUBELNG	Real	Length small	ShellAndTubeHeatExchanger.TubeLengthStraight
A TUBENUM	Integer		ShellAndTubeHeatExchanger.TubeNumber
A TUBEPASSNUM	Integer		ShellAndTubeHeatExchanger.TubePassesNumberPerShell
A SHLSERNUM	Integer		ShellAndTubeHeatExchanger.ShellsInSeriesNumber
A SHLPARNUM	Integer		ShellAndTubeHeatExchanger.ShellsInParallelNumber
N KettleVapourBelt			
A KETLOD	Real	Length small	ShellAndTubeHeatExchanger.KettleDiameterOuter
A KETLID	Real	Length small	ShellAndTubeHeatExchanger.KettleDiameterInner
A VAPBLTOD	Real	Length small	ShellAndTubeHeatExchanger.VaporBeltDiameterOuter
A VAPBLTID	Real	Length small	ShellAndTubeHeatExchanger.VaporBeltDiameterInner
A VAPBLTLNG	Real	Length small	ShellAndTubeHeatExchanger.VaporBeltLength
N Thicknesses			
A SHLCYLTHK	Real	Length small	ShellAndTubeHeatExchanger.ShellThickness
A HNFRCYLTHK	Real	Length small	

FIGURE 6

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DBServer

ClassStore   59
50

ObjectStore   62

RDB Driver   66

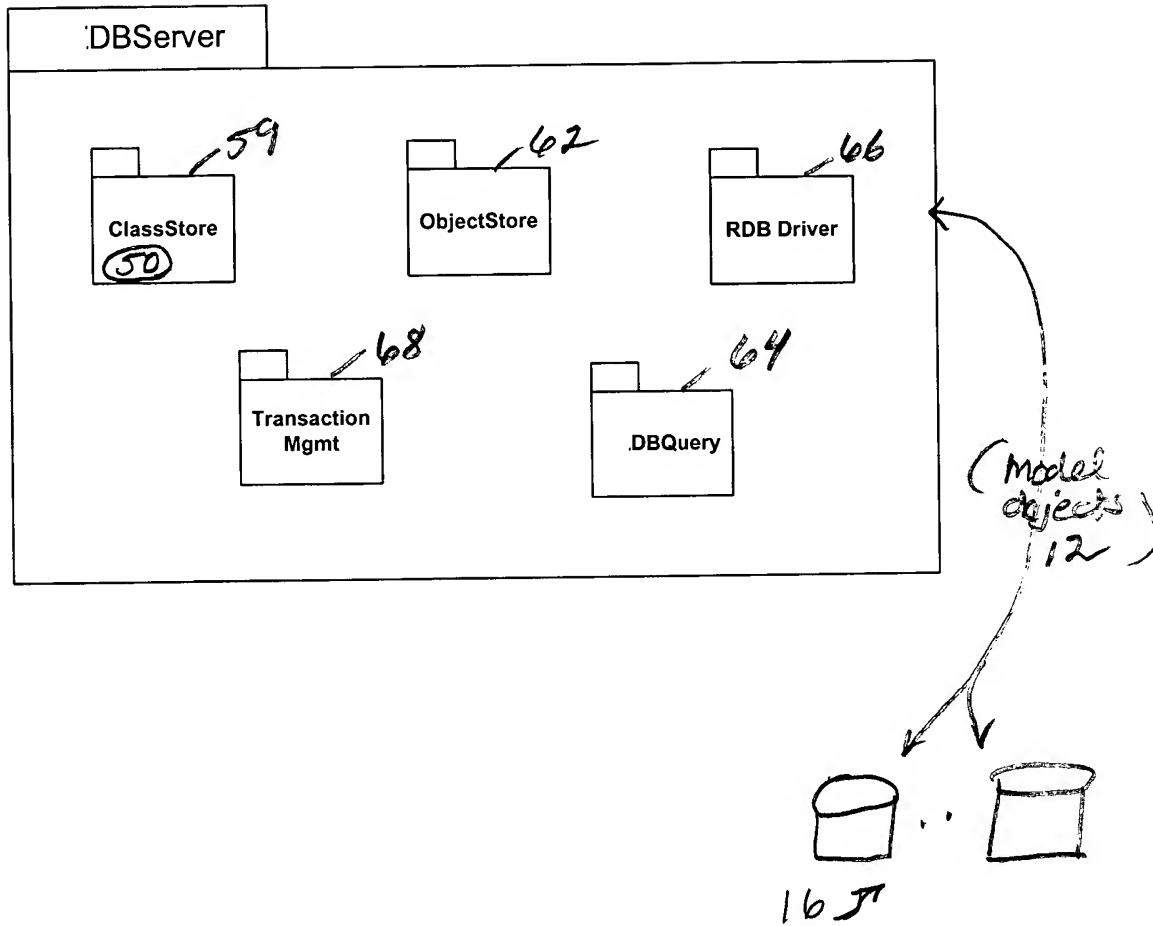Transaction
Mgmt   68

DBQuery   64

(Model
objects
12)

16

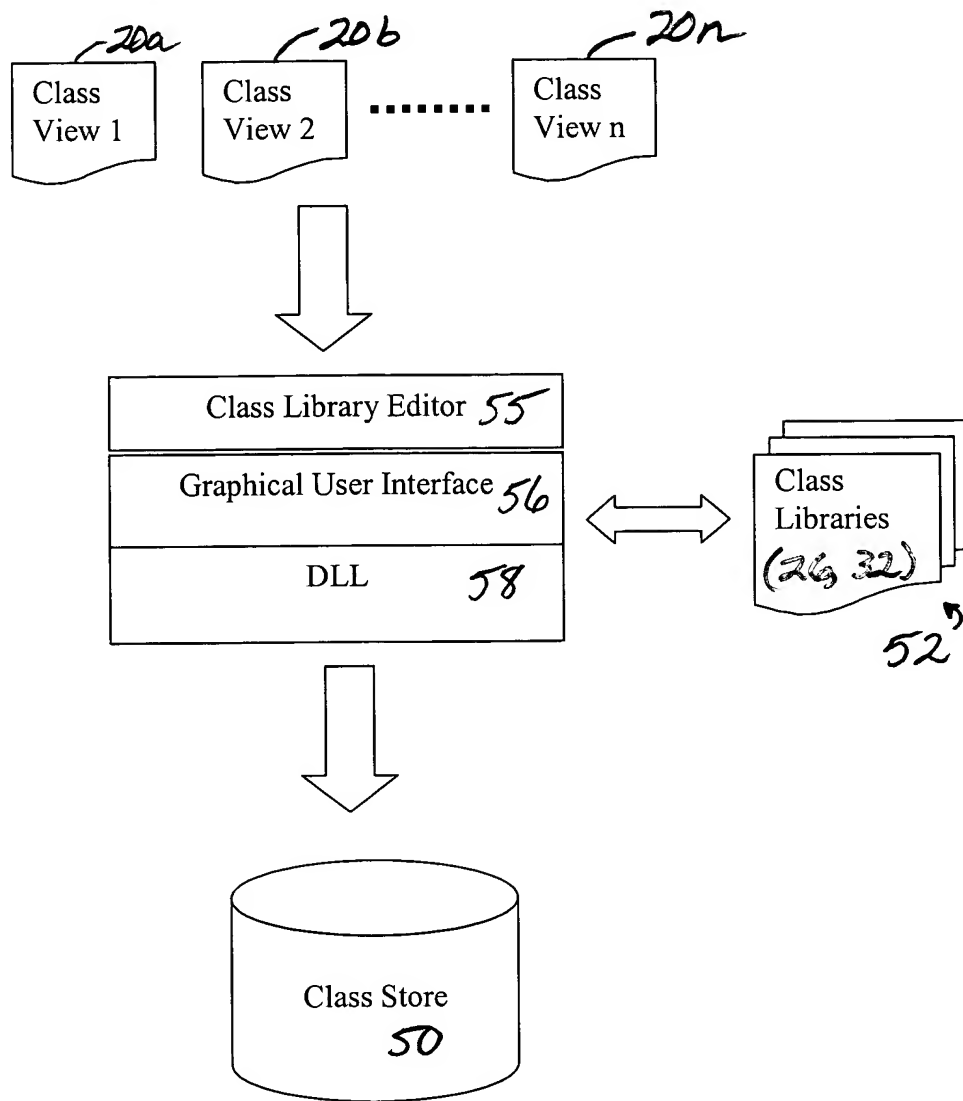Figure 7. Class Library Editor System 54

Figure 8. Flow diagram of the class library editor and data server systems

· 60,54

100 — Create class views 20 for applications

102 — Consolidate class views 20 into a composite class view 30

103 — Create conceptual data model 40

104 — Compile a three-tier data model class store 50 *Comprising* class views 20 , composite views 30, conceptual model 40, and links between the three tiers

106 — Instantiate objects 12 in the data server 60 based on the class store 50 schema definitions